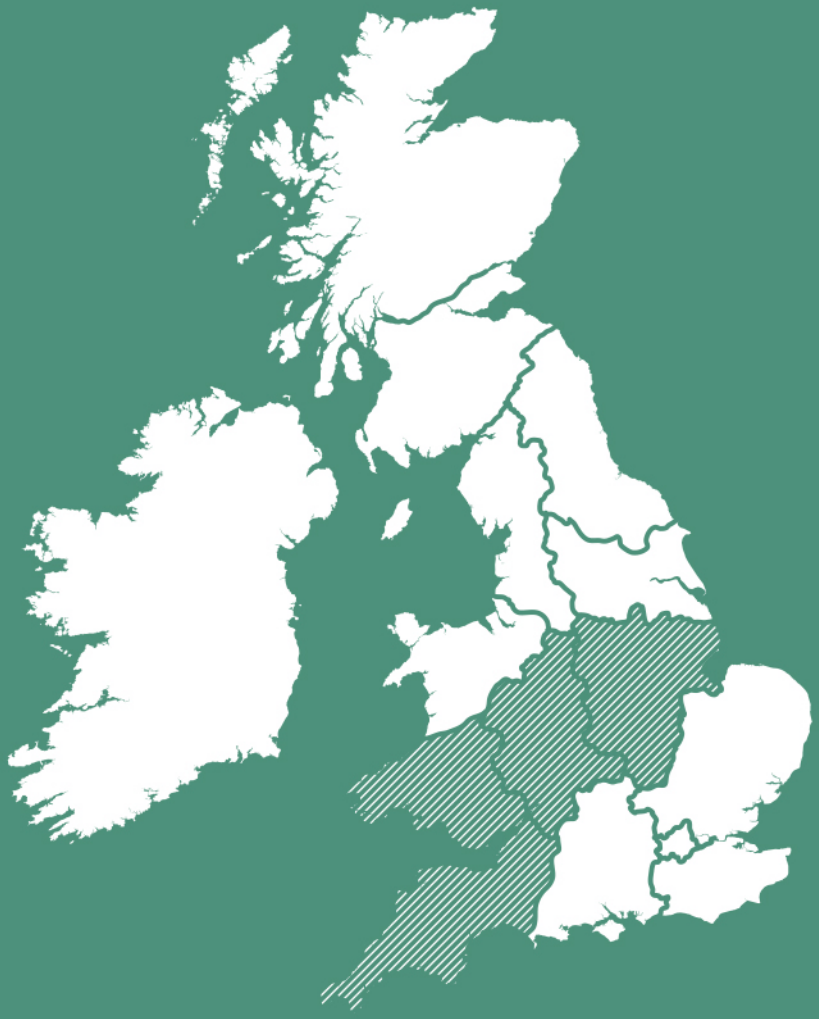
WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

ECHO – ENERGY CONTROL FOR HOUSEHOLD OPTIMISATION

CLOSEDOWN REPORT



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Contents

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Glossary

Abbreviation	Term
DDSR	Domestic Demand Side Response
DR	Demand Response
EST	Energy Saving Trust
DSR	Demand Side Response
DNO	Distribution Network Operator
HEUS	Household Electricity Usage Study
ToUT	Time of Use Trials
WPD	Western Power Distribution
WS3	Work Stream 3

Executive Summary

One of the key solutions envisaged within the Work Stream 3 (WS3) Transform Model is Domestic Demand Side Response (DDSR). In essence this is the ability to remotely control loads on the network through direct control, price signals and planned load shifting. This technique could provide additional network control at times of peak loading, allowing high loads to be actively managed and potentially deferring system reinforcement. With the advent of low carbon technologies, such as electric vehicles and heat pumps, this functionality could become increasingly important as heating and transportation become more reliant on electricity.

Using the data gathered from ECHO, the customer utilisation payments required when instigating a DDSR event equates to approximately £6660/MWh. The initial capital outlay, including equipment, software and control centre, for the purposes of this trial was £325 per connected appliance, which equates to approximately £6 million per MW of available domestic load. As would be expected, full-scale roll-out would reduce costs greatly but it is not envisaged that the reduction would make this method competitive with other approaches.

As example cost comparisons, the average STOR utilisation price, as of January 2015, was £131.94/MWh[1], fifty times less than the figure presented above. Current high end lithium battery estimates put the cost of MW installed at £1.4 million, a quarter of the cost shown above.

In terms of reinforcement, with HV cable installation costing in the region of £150 per metre[2] or a new indoor double transformer substation costing approximately £1,615,000, it would at the present time, be difficult to make a case for DDSR over conventional reinforcement on a local level.

The ECHO project did find that participants were receptive of the idea of DDSR events being run on their large domestic appliances. However, in reality, the effort required to setup the system and iron out any issues quickly demotivated participants. Having to spend time maintaining a system was seen as the biggest obstacle to the long term application of this method of peak-load management.

If a more user-friendly, cost effective and reliable system could enable demand-side response events in the home; it would be useful to revisit research into the potential impact domestic demand side response has on managing electricity consumption during periods of peak demand. Future integration between Time of Use Tariffs, Smart Meters and home appliances should create the opportunity to develop such a system.

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1 Future Potential of DSR in GB, October 2015 – Frontier Economics

2 WPD Statement of Methodology and Charges for Connection to Western Power Distribution (West Midlands) PLC's Electricity Distribution System

1 Project Background

1.1 Problem

With the development of low carbon technologies, such as heat pumps and electric vehicles, there is the potential for a marked increase in load on the electricity network, in particular at peak times. Traditional network investment techniques could be employed to reinforce the network for this peak such as adding larger cables and bigger substations. However more innovative solutions are becoming available including DDSR.

The WS3 Transform Model deploys DDSR solutions in assessing future energy scenarios. Many of the underlying assumptions for the solution have not been validated. At the time of project inception there had been very few practical trials associated with the DDSR technique and little data was available to demonstrate the effectiveness of the technique, particularly within the UK market model.

There was also little data available as to what appliances this can be applied to and which devices will deliver the best demand reduction when an event is instigated.

Consumer engagement will be key to the acceptance of DDSR, however it was unclear as to what attitudes there were to direct load control, and what levels of incentives would be required to change behaviours.

In the future, it is envisaged that smart meters will facilitate DDSR, although a full deployment is not expected until after 2020. Consequently this trial took place without utilising smart metering infrastructure which may have allowed additional learning to be obtained more quickly.

1.2 Method

The Energy Saving Trust (EST) were approached as a project partner to design and deliver the project. The project looked to utilise their database of customers who have registered an interest in taking part in energy saving trials, as well as links to housing associations. 200 customers were planned to be recruited by EST to participate in WPDs trial allowing several statistically representative groups to be created, and a number of incentive scenarios trialled.

Greenlet was selected by EST as the technology supplier for the project due to their experience in appliance control and energy management together with applicability of the products. The Greenlet solution had been previously deployed in a number of similar Demand Response (DR) trials in the United States and Israel. It was planned that each property would receive a number of plugin Greenlet devices which would sit between the socket and the plug of the appliance to be controlled. Each unit would be installed by the customer and collect data on the appliances whilst allowing load control signals to be actioned. The Greenlet plugs create a communications link with a gateway device connected to a domestic broadband service. A head-end software system was planned to be used to schedule the load control events and send signals to the Greenlet plugs to control the loads. A web portal was available to customers to monitor energy usage and help manage appliances remotely.

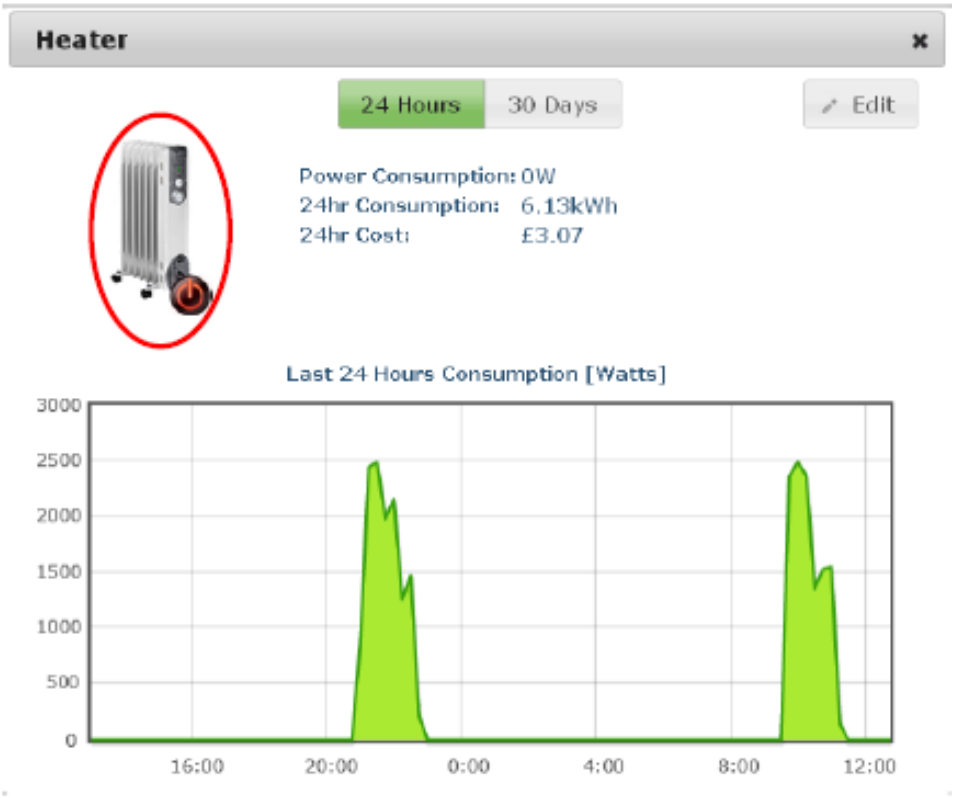

Figure 1 - Greenlet Web Portal Heater Example

To incentivise customers to participate, a range of financial incentives were developed and trialled. It was anticipated that data would be collected through the Greenlet devices and analysed allowing changes to be made to the trial conditions and incentives. Tests would then be repeated to see how results are altered. Finally, conclusions would be drawn from the data collated to meet the project objectives.

2 Scope & Objectives

The project focussed on recruiting 200 domestic installations to meet the following objectives;

- To understand the scale and structure of payments required to ensure behavioural change.
- To quantify the potential changes in peak load through domestic demand response.
- To identify the scope for long term enduring demand response services.
- To evaluate which domestic devices offer the greatest potential load reduction / deferment.
- To ascertain customer appetite in relation to deferment of load.

3 Success Criteria

The success criteria were;

- Recruitment and installation of devices at 200 properties.
- Quantification of the amount of peak load reduction possible through such techniques.
- Update WS3 Transform Model parameters.
- Deliver the project to time, cost and quality.
- Deliver a technology solution that works out of the box.
- To achieve high levels of customer satisfaction.

4 Details of the Work Carried Out

The project was made up of six distinct work elements;

4.1 Integration of Greenlet Software and WIFIPLUG Hardware

Prior to the commencement of the project, Greenlet had already been identified by EST as a suitable provider of the hardware and energy management software. However, as they had previously only operated in foreign markets some additional works were required to bring their product to the UK.

After unsuccessful attempts to re-design the Greenlet ‘Smart Plug’ in order to gain the CE mark, the decision was made to source an alternative manufacturer for the hardware whilst retaining Greenlet as the software provider.

The EST settled on WIFIPLUG as the alternative provider. Their plug was already on the market and WIFIPLUG were also prepared to integrate with the Greenlet software.

Figure 2 - WIFI Plug

Due to the length of time it took to develop the Greenlet offering, and to agree an alternative, followed by the subsequent integration, a change request was sent to OFGEM in order to extend the project to allow a reasonable length of time to collect data. This change request also meant that when the project was extended it has to be reregistered as an NIA.

4.2 Site Selection

In parallel with the hardware and software development, EST undertook an exercise to identify appropriate households to participate in the DDSR field trial from both the private and social housing sectors and then further categorise them into one of four user archetypes defined below. 190 households from across the Midlands were recruited and comprised of private homeowners, private tenants and social tenants.

Private homeowners and private tenants were recruited through the EST mailing lists. These were also members of the public who had expressed an interest in being part of energy efficiency trials.

Social tenants were recruited through partnering with three housing associations; Orbit, Accord and Sanctuary. The housing associations in turn, contacted tenants through their own communication channels and invited residents to take part.

There were limitations to the recruitment approach of the private tenants and householders. Owing to the fact that they had previously expressed an interest in taking part in energy efficiency trials, the energy awareness and sector knowledge of private householders was higher than average. This was evident from the fact that 52% of the sample were familiar with the concept of demand-side response prior to the trial beginning, whereas participants in the social housing category required more help understanding the concepts and project objectives. This is likely to be because the social housing participants were recruited outside of EST mailing lists, and were not likely to be as familiar with demand response as the private tenants.

It was found to be more challenging to recruit and engage with social housing tenants, due to the population being smaller than private homeowners/tenants. The response rate to the initial recruitment communications was lower compared to the private homeowners/tenants.

To ensure the research project produced lessons that could be applied cross the entire WPD licensed areas, EST identified four household archetypes. These reflected the households situated in the WPD distribution area and were defined from clusters of households segmented from the English Housing Survey 2010-11 in the East and West Midlands.

Category	Description
1	Working Adults in Households Without Dependent Children
2	Working Adults in Households with Dependent Children
3	Workless Adults with or Without Dependent Children
4	Retired Adults with or Without Dependent Children

The aim was to recruit an equal amount of people in each category. However, recruiting people in the workless category proved most difficult, followed by Category 1, working adults without children. Recruiting people in the retired category was easier than other categories and there was a surplus of respondents in the working with children category.

The number of appliances that customers could potentially control differed according to demographic factors. Customers with lower incomes were likely to have fewer controllable appliances and less to offer in terms of peak demand reduction. While all customers benefit equally from reduced reinforcement costs, DDSR schemes are likely to offer more opportunities for rewards to customers with higher incomes.

4.3 Identify Householder Incentive Scheme

Referencing a number of similar field trials in the United States, EST undertook physical and virtual workshops to establish the appropriate customer incentives. EST originally set out to offer a number of optionsof customer incentives based on the United States trials together with their own previous experience.

EST developed ‘terms of reference’ setting out the guidelines for participation in the field trial and explaining the conditions that participants must fulfil in order to qualify for the incentive. EST then continually monitored householder compliance with those terms of reference to ensure that any incentives were only offered to those householders that fulfilled their obligations.

Data protection processes were employed throughout.

4.4 Finalise Greenlet Software Development for UK Market

EST used the results and feedback from pilot testing to finalise the development of Greenlet software for use in the UK market.

4.5 Help Desk Support

The EST set up a help desk consisting of a trained advisor to answer queries from field trial participants pertaining to the set-up or use of the DDSR equipment.

4.6 Demand Response Trial Management

Each participating household received two WIFIPLUG smart plugs, along with instructions on how to install the devices themselves. These devices were installed between the socket and the selected appliance. The devices monitored the appliances electricity consumption and also created a communication link to the Greenlet software system, which was used to schedule demand-side response events.

EST provided on-going management of the trial which included the following key activities;

- Undertake regular correspondence with and receive feedback from participants.
- Monitor the performance of the Greenlet appliances to ensure that participants are using the units.
- Undertake data collection; handling; and data analysis.
- Use of EST's Sharepoint or EMBED database to upload data for the team to view.

5 The Outcomes of the Project

5.1.1 Customer Engagement

E-mail was found to be the best form of communication with a 31% response rate to the invitation to households to participate in the project (800 initial emails were sent, 250 expressions of interest were received). Out of 300 letters sent as hard copies, only 7 responses were received, which equates to a 2% response rate. Because of this poor letter response rate any secondary recruitment was undertaken via e-mail only. However, this approach does limit the potential participants to only those demographics who regularly use e-mail.

The table below shows the profiles of participants successfully recruited.

Archetype	%
Private Household (Owner Occupied, Privately rented)	56
Social Tenants	40
Housing Association Staff	4

Table 1- Tenancy Type of Existing Sample

Demographic Split	%
Working with Children	54
Working without Children	12

Workless	9
Retired	25

Table 2 - Demographic Split of Participants

Out of the 190 households originally recruited, 13% did not maintain any communication with the project team after receiving their welcome pack and smart plugs. As there was no further communication with these participants, the reasons for them dropping out are unclear. A further 12% proactively got in touch to inform the project team that they were no longer able to take part due to issues with the technology and returned their devices. Another 12% of households chose to leave the project for reasons other than technical difficulties with their devices; these included moving house, health reasons and loss of interest in the project.

Should this DDSR technique be utilised within BaU then this 37% potential dropout rate would have significant cost implications on the processing, retesting and redeploying of returned hardware.

5.1.2 Scale and structure of payments required to ensure behavioural change

Using data gathered from the project a number of conclusions can be drawn regarding the payments required for each appliance.

Dishwasher

During the morning peak times, most people would accept 50p or over to have their dishwasher made unavailable for use. The same was observed for the afternoon peak, with most people willing to accept 50p or above. In the evening however the level of reward people would be happy to accept goes up to £1, which is likely to be due to the need for dishwasher usage after evening meals.

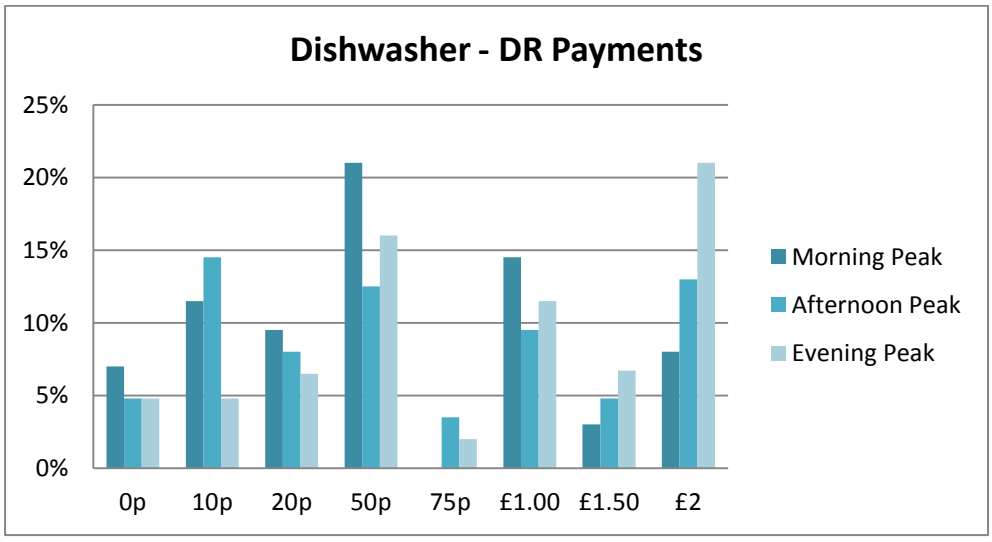

Figure 3 - Level of Reward required to take part in a Demand Response Event (Dishwasher)

Washing Machine

Most participants would be happy to accept 75p or above for taking part in a demand response event during the morning peak period. In the afternoon and the evening period, the majority of participants would accept £1 or more. The washing machine demanded higher payments than other white goods and thus would fall further down any prioritised DR scheduling.

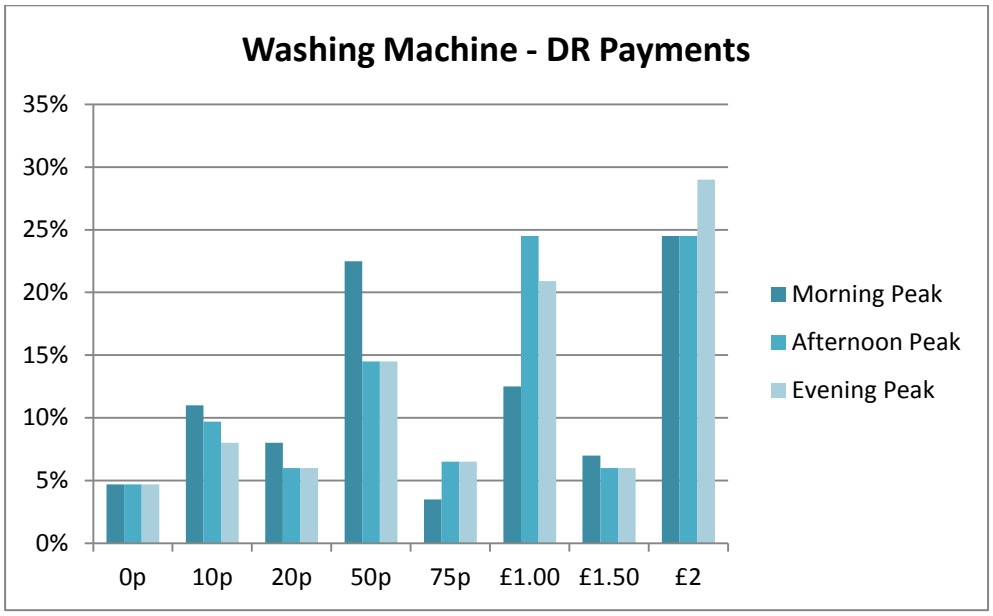

Figure 4 - Level of Reward required to take part in a Demand Response Event (Washing Machine)

Tumble Drier

Participants were willing to accept a slightly smaller reward to defer tumble dryer use, in comparison to washing machines, with most people happy to accept 50p or more during the morning peak period and 75p and above for the afternoon and evening period. Because of the nature of the trial seasonal variations were difficult to establish but it is assumed that tumble drier payments would only be made during the winter months.

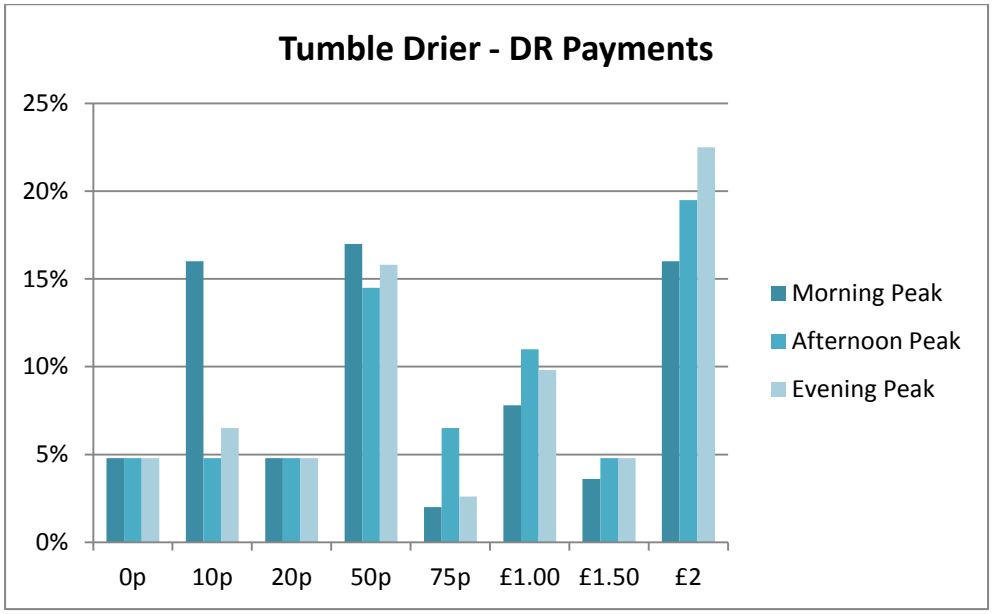

Figure 5 - Level of Reward Required to take part in a Demand response Event (Tumble Drier)

Electric Heater

During the morning peak period, most participants would accept 50p or over to not use their electric heater. During the afternoon and evening peak most people would accept over £1. During the evening peak period the majority of respondents would accept a minimum of £2 to not use their electric heaters, which is when temperatures are lower and space heating is required the most. Again, seasonal variations could not be distinguished but it assumed these payments would only be applicable during the winter months.

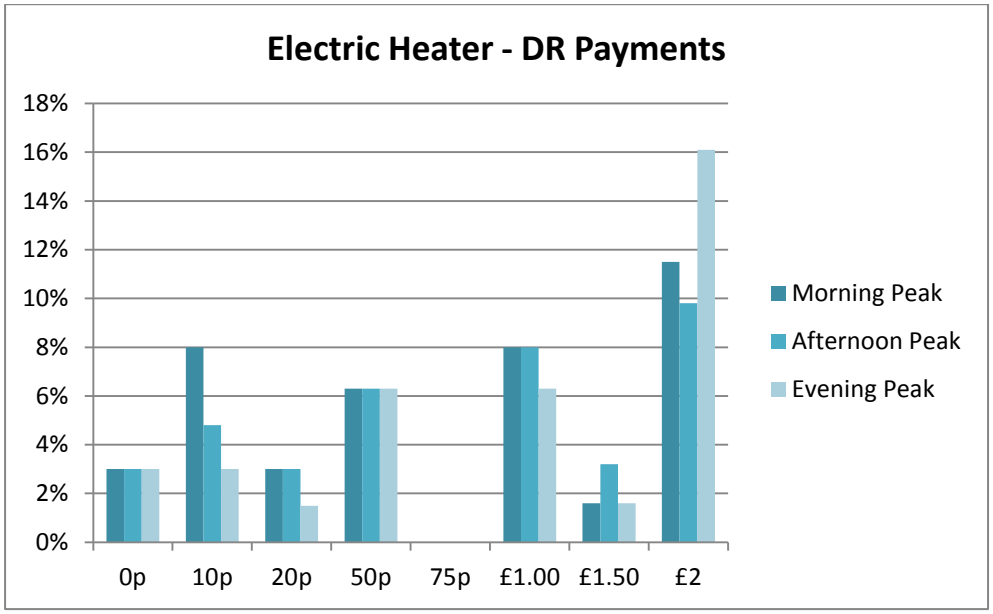

Figure 6 - Level of Reward Required to take part in a Demand response Event (Electric Heater)

Event Duration

As anticipated the longer the duration of the DR event the less willing the participants were to take part. Willingness levels to take part in a DR event which lasts 30 minutes was very high; between 71% and 87% or participants responding positively. Overall, participants were less willing to take part in a longer, 2 hour, event during the evening peak time.

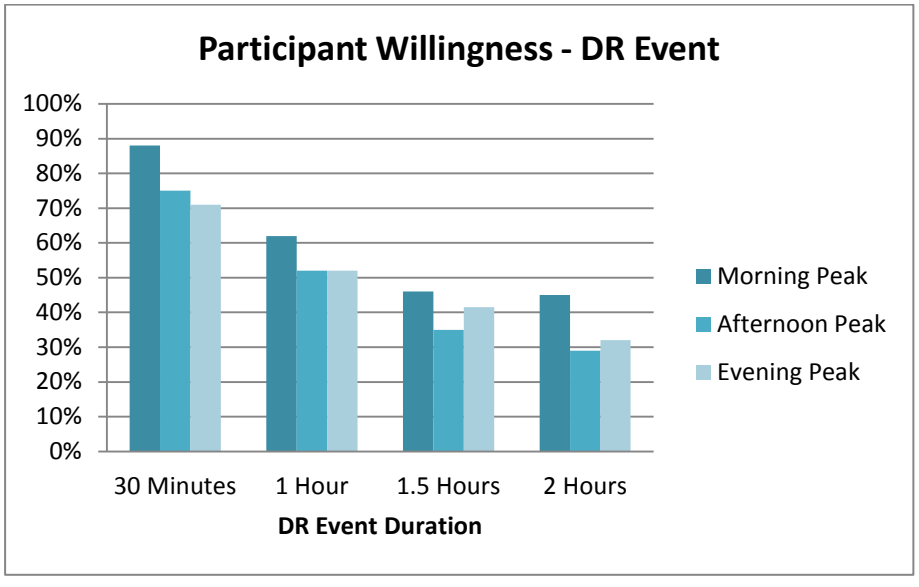

Figure 7 -Participant Willingness to take part in a Demand-Response Event

5.1.3 Scope for Long Term Enduring Demand Side Response Services

By using responses from the closing survey it can be seen that the overall response to the concept of demand-side response in the home was positive, with most participants willing to regularly take part in any future roll-out. Where people were not keen to take part, unreliable smart plug devices or difficult-to-use hardware were cited as the reasons.

The majority of participants were in favour of taking part in two to three DR events per week, with 40% saying they would be happy to take part on a daily basis. Most participants were happy to take part as long as they were given at least one week's notice. When asked if they preferred to take part in a demand response event by default and opt-out if they did not want to take part; or if they preferred to not take part by default and opt-in if they wanted to be part; there was a preference for the former. And over a third of participants expressed no preference between the two.

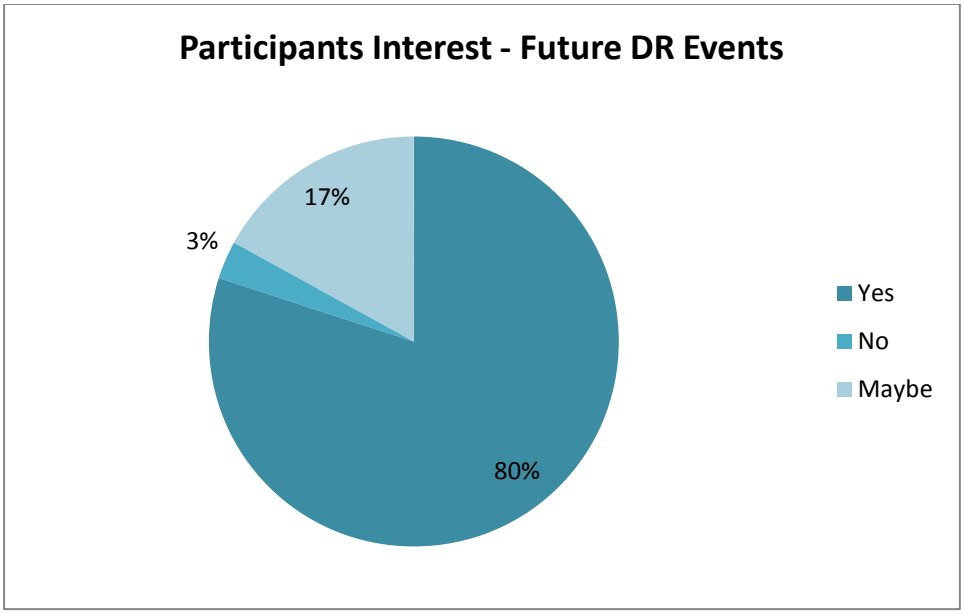

Figure 8 – Participants interested in regularly taking part in any future DR events

Interestingly less participants thought the technique was a good way to manage supply and demand than were happy to participate in the future, with 65% feeling the technique would be useful.

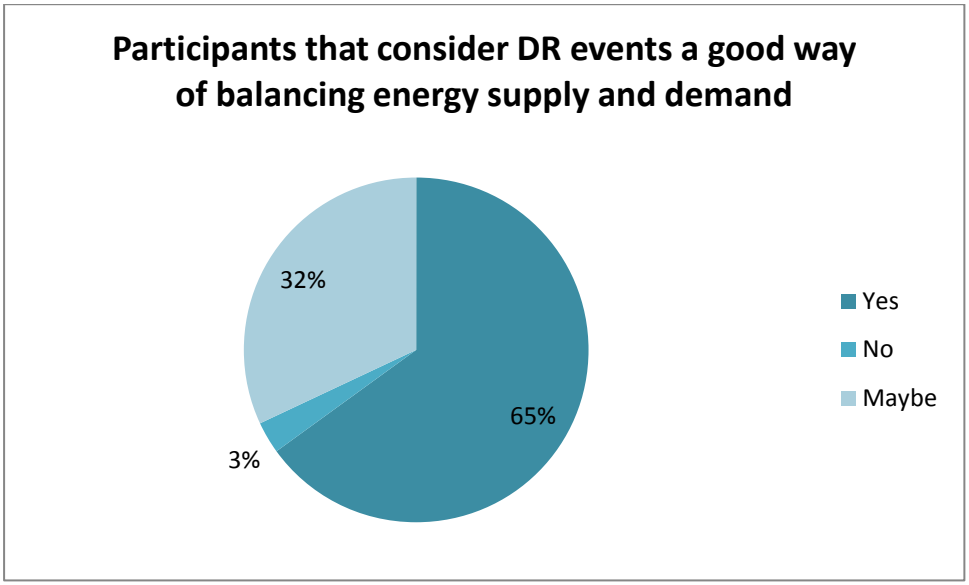

Figure 9 – Participants that consider demand response events a good way of balancing energy supply and demand

In terms of rewarding customers, only 4% of participants would take part with no reward with the rest split over how they would like to receive incentives.

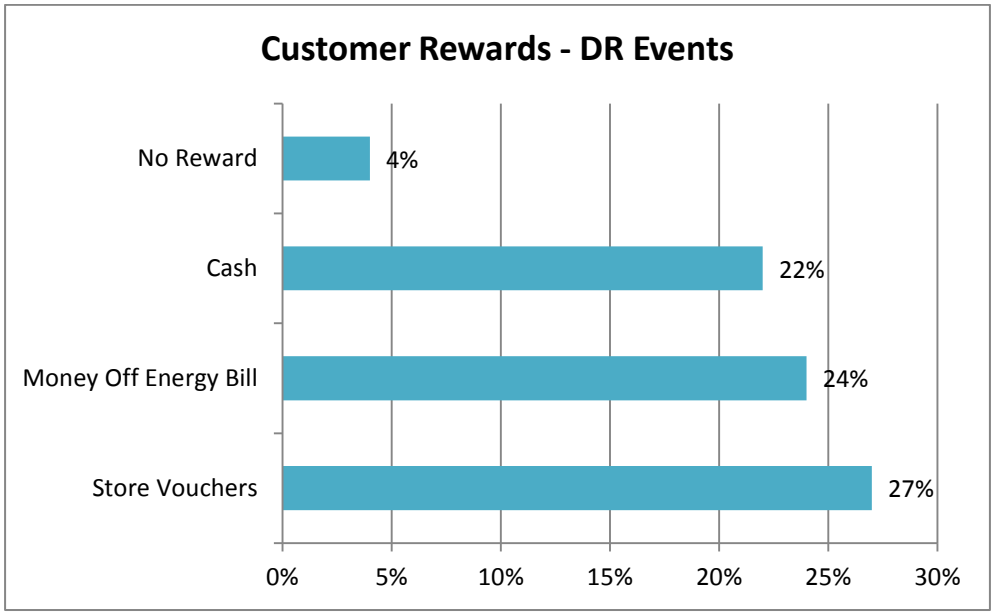

Figure 10 - Motivation to regularly take part in future DR events

5.1.4 Update WS3 Transform Model parameters

Suggested changes to the WS3 Transform Model following the ECHO project for Smart Variant – DSR (DNO led residential DSR) are as follows;

Solutions Headroom

By applying the technology used within the project it can be assumed that for category "DSR – DNO to residential" the solutions headroom released is 0% for all "Solution Headroom Impacts" (Thermal Transformer/Thermal Cable/Voltage Headroom/Voltage Legroom/Power Quality/Fault Level). This is based on the issues encountered with hardware and wireless connectivity which makes a full scale roll-out using the existing hardware difficult to envisage.

However, if a solution to the poor functionality of hardware is found then the potential solutions headroom has been calculated as 7.5% across Thermal Transformer & Thermal Cable during the evening peak. This assumes 100% penetration of DSR enabled appliances (Cold Appliances/Washing Machines/Tumble Dryers/Dishwashers) and a one hour demand response event.

Solution Costs

Using the data gathered the cost per demand response event equates to approximately £6660/MWh. The initial capital outlay, including equipment, software and control centre, for the purposes of this trial was £325 per connected appliance, which equates to approximately £6 million per MW of available domestic load.

As would be expected, over the duration of the project, costs fell and the technology moved on. With a DSR facility built in to the home appliances themselves it would be expected that costs could be greatly reduced. Appliances with built in DSR features would also reduce the practical issues that were experienced where there was little space behind built-in appliances for the Wi-Fi plug and where WiFi reception was affected by the socket being located behind the appliance itself. Including a simple timer on appliances, combined with assessment of smart meter data to determine appliance use at peak times and a text based notification of demand response events could provide a low cost alternative mechanism. As it stands, cost reductions would need to be significant to create a positive business case for DDSR.

Merit Order

The outputs of the project agree with the existing assumptions of high disruption and low flexibility. However, with the introduction of Smart Appliances this is likely to be reduced.

Enablers

The current enablers of "Communications to and from the devices" and "DSR – Products to remotely control loads at consumer premises" are still relevant. Based on the feedback and experience with additional hardware from this project it is suggested that the latter is changed "Smart appliances able to schedule loads at consumer premises".

For Smart Enabler "Communications to and from the devices" it is suggested that the disruption factor is changed to 3. This is because the 'last mile' communication is over the consumers Wi-Fi which caused issues during the trial requiring consumer intervention, and thus disruption.

For Smart Enabler "DSR – Products to remotely control EV charging", it is suggested that the Capital costs are amended in line with the findings from this project. Additionally, until 'Smart Appliances' become available there is a significant factor associated with the installation of the products, a suggested 4. However, as per this trial, the product location can change, so a change in the 'Flexibility' rating is suggested, to 2.

6 Performance against Project Aims, Objectives and Success Criteria

To understand the scale and structure of payments required to ensure behavioural change.

The level of payments required to ensure behavioural change differed depending on the time of day of the demand response event and the type of appliance being controlled, the details of which have been covered in the previous sections. As a 'rule of thumb' the majority of participants were accepting of a £1 demand response event for any of the three peaks (morning, afternoon or evening) for any appliance, provided that there were only three response events per week which lasted no more than an hour and that they had one week's notice.

To quantify the potential changes in peak load through domestic demand response

Using outputs from the project it is anticipated that, on average, the peak load can be reduced by 75w per household. This figure falls in line with other Time of Use Tariff (ToUT) trials and the appliance based estimate of technical peak shifting potential from the HEUS[3]

To identify the scope for long term enduring demand response services and ascertain customer appetite in relation to deferment of load

The project found that the recruited participants were receptive to the idea of load deferment. However, without significant development and cost reduction in the solution it is unlikely that domestic demand response services will become a viable solution in the near future. Equally, the difficulty in both recruitment of participants and maintaining of their interest shows that any enduring solutions require careful design and management, ideally with minimal participant interaction.

To evaluate which domestic devices offer the greatest potential load reduction / deferment

From the project outputs it can be seen that the washer dryer and dishwasher present the greatest potential for load deferment due to their year round use, consumer flexibility, together with consumer willingness to except smaller reward for use deferment.

Recruitment and installation of devices at 200 properties

[3] Electricity Price Signals and Demand response, April 2014 – Element Energy Limited

By the end of the project 190 properties had been recruited. This figure is slightly less than the 200 properties originally proposed. However, given the levels of response to initial recruitment communications together with the subsequent number of ineligible households identified within the respondents, the figure of 190 brings with it a great deal of useful learning. That learning we feel will be a useful input into the wider DDSR debate. The industry need to thoroughly debate this because our project shows that it is prohibitively expensive and this to be addressed if the industry is to pursue this mechanism as part of a broader set of tools for system management.

Update WS3 Transform Model parameters

From the outcomes of this project the suggested WS3 Transform Model parameter changes are detailed in Section 7.1.4 covering the following areas;

- Smart Variant – DSR (DNO led residential DSR).
- Smart Enabler - Communications to and from the devices.
- Smart Enabler - DSR - Products to remotely control EV charging.

Deliver the project to time, cost and quality

As mentioned previously, OFGEM accepted the request to extend the project due to the time taken to develop the Greenlet offering. The project was delivered to time in line with the revised date and cost, project quality was maintained throughout by utilising project controls as defined in the WPD Future Networks Team Project Governance Guidelines. These project controls include a number of processes covering internal reporting, approval, risk management, defined document control and project change.

Deliver a technology solutions that works out of the box

The WIFIPLUGs require a connection to the household WIFI router in order to communicate with the Greenlet Energy Management System (EMS). Maintaining a constant connection between the WIFIPLUG devices and the home WiFi and also between the WIFIPLUG servers and the Greenlet EMS was the biggest obstacle to data collection during the project.

Limitations of the “straight out of the box” WIFIPLUG;

- Poor WIFI sensitivity of the plugs; participants reported that although their home WIFI was of good strength the WIFI plugs would drop offline and require re-set.
- A number of users reported faulty plugs.
- Difficulties with set-up; participants reported having difficulties completing the initial set-up, many of which required lengthy telephone support and other not managing to complete it at all.
- Issues with WIFIPLUG server; updates to the server caused devices to drop offline. Once devices had been dropped offline they required a reset in order to reconnect.
- Dual band routers; the devices are incompatible with dual-band routers.

Limitations of the Greenlet software system;

- The Greenlet system relies on energy consumption pattern recognition algorithms in order to establish the type of appliance connected to it. The system requires the appliance type information before a demand-side response event can be scheduled on that appliance. However the algorithm requires a steady communication with the appliance for a period of a few days before it can determine the type. Due to the intermittency of connections of the devices in a number of cases the appliance type was not able to be established; hence it was not possible to schedule demand-side response events on these units.
- While this algorithmic approach to appliance identification has the benefit of saving the users from having to identify the appliance it would seem more of a hindrance than a benefit for customers with only two devices to identify.

In summary, the WIFIPLUG, whilst already publically available, did not perform satisfactorily. Whilst the Greenlet software had the limitation mentioned above, this was only an issue due to the WIFIPLUGs failings, therefore it would be unfair to make any overall conclusions on the suitability of the software.

Based on internal observations and participant feedback it has to be concluded that the project could not deliver a technology solution 'straight out of the box'. There are a number of factors within this, but WPD would be happy to be involved in a wider debate as to how best to progress the technological side of DDSR.

To achieve high levels of customer satisfaction

Feedback taken from participants following the closure of the trial showed high levels of customer satisfaction with the trial intentions; however there was a general frustration in the performance of the plugs themselves. For example;

"It was a worthwhile attempt but I feel the devices and app were a bit too difficult and time consuming to be bothered with in the long time. It needs to be much easier to set up and use for me personally."

"Totally happy to take part and help, but very busy lifestyle means it was really difficult to find the time to try and resolve problems, let alone in work hours."

"I enjoyed the project and I was intrigued to see how much energy I saved."

"The concept is great but it took a significant amount of time to run the programme, the wifi plugs were very difficult to use - once set up and turned on they wouldn't stay on for more than 5 minutes - unless that issue is resolved they would be unworkable"

7 Required modifications to the planned approach during the course of the project

7.1 Change of Hardware Provider

In July 2014 a formal change was prepared and approved (See appendix A) as it became apparent that Greenlet could not supply smart plugs which met the required standard for use in the UK as it had plug had a number of issues which would prevent it gaining CE marking. These included the absence of shutters to prevent access to live parts within the plug and the plug face not meeting minimum size requirements. While there was an attempt to correct these defects it became clear that Greenlet were not going to be able to supply devices of a high enough standard within the required time frame.

Milestones were affected by these delays while Greenlet provided a prototype and attempted to correct the manufacturing errors. Additional delays ensued whilst finding suitable alternative suppliers for both the smart plugs and control software. These delays to the start of the demand side management trials meant that the project end date was moved back to February 2016.

WIFIPLUGS were identified as a suitable alternative plug provider, with Greenlet remaining as the provider of energy management software.

8 Significant variance in expected costs and benefits

The project remained within cost throughout, even though the length of the project changed. The expected benefits were lower than expected due to the difficulties in maintaining customer engagement together with hardware and software issues. However, some useful learning can be taken from the project and applied to any future works in this field.

	Budget	Actual
Energy Saving Trust[4]	£263,850	£255,604.50
Project Management	£19,000	£44,238.87
Contingency	£47,150	-
Substation Monitoring[5]	£20,000	-
TOTAL	**£350,000**	**£299,843.37**
DNO Contribution		£29,984.34
NIA Contribution		£269,859.03

[4] This also included the customer incentive payments.

[5] It was deemed that the installation of monitoring would not represent value for money given the small sample size of customers.

9 Lessons learnt for future projects

9.1 Hardware Changes

The process to alter the existing Greenlet product for the UK market was not considered to be an issue at project start up. In reality the failure to provide suitable alterations had a major effect on the success of the project. Any future projects should, where possible, have the risk taken outside of the project itself, i.e. Greenlet should have provided a CE approved plug prior to project start.

9.2 Hardware Testing

Following the failure of Greenlet to provide an appropriate plug, WIFIPLUG were chosen by EST as a new provider of the hardware. Clearly the ESTs appraisal process was unsuitable as the product got rolled out before the major limitations of the device were noted.

10 Planned Implementation

It is not planned to replicate the method of demand side management as trialled in the ECHO project. It is clear from the overall cost, participant behaviour and final feedback that the methodology would not be suitable for wider rollout.

Based on the feedback received, suggested further work would centre around WIFI enabled ‘smart white goods’ which require no customer interventions in order to manage their own schedules around network demand. Removing the customer from the process would ultimately allow for greater levels of flexibility as devices could be controlled at shorter notice.

11 Facilitate Replication

11.1 Knowledge Required

Whilst no specialist knowledge is required for repetition, it is worth noting the learnings from this project before trying to replicate it. Particularly the difficulties in both initially recruiting and subsequently maintaining the interest of participants.

11.2 Products/Services Required

Three are three key elements to allow for successful replication of this project;

1. Embedded consumer appliance controller to enable control signals to be actioned. In the future it is anticipated that the controller is built within the appliance itself.
2. Centralised control system (Including necessary communications links)
3. Telephone and e-mail customer support for the lifetime of the trial

12 Points of Contact

Further details on replicating the project can be made available from the following points of contact:

Future Networks Team,
Western Power Distribution,
Pegasus Business Park,
Castle Donington,
Derbyshire,
DE74 2TU.
wpdinnovation@westernpower.co.uk

Appendix 1 – Revised ECHO Pro-forma

LCN Fund
Low Carbon Networks

Registration Date
02-Aug-2013

First Tier Pro-forma

Notes on completion
Before completing this form, please refer to the LCN Fund Governance Document. Please use the default font (Verdana font size 9) in your submission, the text entry areas are predetermined and should not be changed. Please ensure all content is contained within the boundaries of the text areas. The full-completed submission should not exceed 4 pages in total.

Project title
ECHO - Energy Control for Household Optimisation

DNO
Western Power Distribution (East Midlands)
Participant DNOs
WPD East Midland, WPD West Midlands, WPD South West, WPD South Wales

Project summary
One of the key solutions envisaged within WS3 Transform Model is Domestic Demand Side Response. In essence this is the ability to remotely control loads on the network through direct control, price signals and planned load shifting. This technique could provide additional network control at times of peak loading, allowing high loads to be actively managed and potentially deferring system reinforcement. With the advent of low carbon technologies, such as electric vehicles and heat pumps, this functionality could become increasingly important as heating and transportation become more reliant on electricity. While the WS3 Transform Model is being used extensively for investment planning purposes, there is limited data on the effectiveness of domestic demand side response. The technology solutions required are unproven and there is limited evidence as to what appliances are best directly controlled. Consumer attitudes and acceptance is also unknown, including the level of incentives required to drive behaviour change. Project ECHO will look will utilise a number of off-the-shelf interactive plug-in devices that will facilitate the scheduling of loads for individual domestic appliances at two hundred premises. A range of incentives will be trialled with statistically representative groups and monitoring undertaken to gauge take-up of demand response events.

Problem(s)
Please provide a narrative which explains the Problem(s) which being addressed by the Project.
With the advent of low carbon technologies, such as heat pumps and electric vehicles, there is the potential for a marked increase in load on the electricity network, in particular at peak times. Traditional network investment techniques could be employed to reinforce the network for this peak such as adding larger cables and bigger substation. However more innovative solutions are becoming available including Domestic Demand Side Response (DDSR) The WS3 Transform Model deploys DDSR solutions in assessing future energy scenarios. Many of the underlying assumptions for the solution have not been validated. There have to date been very few practical trials associated with the DDSR technique and little data is available as to the effectiveness of the technique, particularly within the UK market model.

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Problem(s) continued

There is also little data available as to what appliances this can be applied to and which devices will deliver the best demand reduction when an event is instigated.

Consumer engagement will be key to the acceptance of DDSR, however it is currently unclear as to what attitudes are to direct load control, and levels of incentives required to change behaviours

In the future, in is envisaged that smart meters will facilitate DDSR, although a full deployment is not expected till 2020. Subsequently this trial will take place without utilising smart metering infrastructure to allow learning to be attained quicker.

Method(s)

This section should set out the Method or Methods that will be trialled in order to solve the Problem. The type of Method should be identified where possible e.g. technical or commercial.

The Energy Saving Trust (EST) were approached as a project partner to deliver the consumer recruitment and engagement aspects. They have used their data base of customers who have registered an interesting in taking part in trials, as well as links to housing associations. Two hundred customers have been recruited by EST to participate in the trial allowing several statistically representative groups to be created, and a number of incentive scenarios trialled.

Greenlet were originally selected as the technology supplier, however manufacturing issues with the UK version of their plugin device have resulted in selecting an alternative suplier, Wifiplug. Each property will receive a number of plug-in devices which sit between the plug socket and the appliance to be controlled. Each unit can be installed by the customer, and will collect data on the appliances whilst allowing load control signals to be actioned. The Wifi plugs create a communications link with a gateway device connected to a domestic broadband service. A head-end software system will be used to schedule the load control events and send signals to the Wifi plugs to control the loads. A web portal is available to customers to monitor energy usage and help manage appliances remotely.

To incentivise customers to participate, a range of financiall incentives will be developed and trialled. Data will be collected through the Wifiplug devices and analysed allowing changes to be made to the trial conditions and incentives. Tests will be repeated to see how results are altered.

Scope and Objectives

Please describe the scope and objectives of the Project should be clearly defined including the benefits which should directly accrue to the Distribution System.

The project will recruit 200 domestic premises to trial a number of DDSR scenarios and meet the following objectives.
- To understand the scale and structure of payments required to ensure behavioural change.
- To quantify the potential changes in peak load through domestic demand response
- To identify the scope for long term enduring demand response services
- To evaluate which domestic devices offer the greatest potential load reduction / deferment.
- To ascertain customer appetite in relation to deferment of load

The benefits of the scheme will be a report updating the assumptions in the WS3 Transform Model associated with domestic demand response.

Success Criteria

Please give details of how the DNO will evaluate whether the Project has been successful.

- Recruitment and installation of devices at 200 properties
- Quantification of the amount of peak load reduction possible through such techniques.
- Update WS3 Transform Model parameters
- Deliver the project to time, cost and quality
- Deliver a technology solutions that works out of the box
- To achieve high levels of customer satisfaction

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TRL 7-8	
This should be between 5-8 to be eligible for Tier 1 Funds.	
Predicted start and end dates.	
DNOs should provide an estimate of the expected project starting and completion dates.	
Start Date: 08/2013	End Date: 01/2016
Project partners and external funders	
Please give details of actual or potential Project Partners and External Funding Support as appropriate	
The project will be delivered through the Energy Saving Trust (EST), providing recruitment and call centre support services. Greenlet Technologies have been selected by EST as a technology partner	
Potential for new learning	
Detail what the parties hope to learn and how the learning will be disseminated.	
It is anticipated that new learning will be generation associated with consumer attitudes to DDSR. It is also intended that this scheme will generate an improved knowledge of the scale of domestic load control possible, feeding into future investment planning models. Additional learning will also be generated to update parameters in the WS3 Transform Model.	
Risks	
The DNO should highlight any material, known risks that could impact the Project's costs and/or programmes.	
There is a risk that customers will not want to participate in the trial. To minimise this, EST has been selected to front the customer recruitment and support as an independent and trusted third party. It may also be possible that the Greenlet devices may not be able to communicate with the gateway device due to the fabric of the structure. Call centre support will be provided by EST to help customers, and if issues cannot be resolved, the equipment will be returned and additional customers selected. Finally, financial incentives offered are not sufficient to stimulate behavioural change. The levels proposed in this scheme have been based on EST's experience in other projects, and should allow us to ascertain their applicability to business as usual scenarios.	
Scale of project	
Please justify the scale of the Project. In particular, the DNO should explain why there would be less potential for new learning if the Project were a smaller scale.	
The project is planning to recruit 200 domestic customers across a range of social-economic groups. These will be selected from a database of interested customers at EST, and through housing associations. A number of statistically representative sub groups will be created to allow a range of trial scenarios to be completed.	
Geographical area	
Details of where the Trial(s) will take place. If the Project is a collaboration, the DNO area(a) in which the Trial(s) take place should be identified.	
This project does not depend on a specific geography to achieve its core objectives. Conclusion will be drawn across a range of properties, independent of location.	

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Estimated Project funding			
An indication of the revenue allowed for within the DPCR5 settlement that is likely to be saved as a result of the project.		*An indication of the total Allowable First Tier Project Expenditure that the DNO expects to reclaim the for the whole project.*	
Revenue allowed for in the DPCR5 Settlement (£)	Nil	**Indicative total Allowable First Tier Project Expenditure (£)**	£350,000

Please tick if the project involves making payments to related undertakings	
The DNO must set out all payments that it proposes to make to itself or any Related Undertaking. Further, if a payment is to be made to any Related Undertaking that is a Distribution System User, the DNO must demonstrate that it has offered the same terms to similar Distribution System Users on the part of the network that is within the Project boundary and has used reasonable endeavours to identify such Users.	

Please tick if the project conforms to the default IPR arrangements set out in the LCN Fund Governance Document?	✓
The DNO should indicate if the Project does not conform to the default IPR conditions. A justification for alternative arrangements and why the Project should still be approved must be provided, in accordance with paragraph 2.18 of the Governance Document.	

Please tick if you do not consent to the First tier pro-forma being published in full. If you do not consent please identify any information in the completed First Tier LCN Project Registration that you do not wish to be published.	
The DNO must demonstrate that it (or its Project Partners) will face commercial harm from its disclosure and that information is considered eligible for exemption under the Freedom of Information Act 2000 or the Environmental Information Regulations 2004. *All information submitted within the First Tier LCN Project Registration Pro-forma will be made available on the Ofgem website, unless Ofgem has agreed otherwise as part of the Registration process set out above.*	

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